

burial-grounds. The traveller has collected some 3,000 zoological and 300 botanical specimens, besides a splendid series of Kanaki skulls; all these collections were packed ready for conveyance to Berlin when he sent the news. On July 27 he left Honolulu for Jaluit (Bonham) in the Marshall group, and has no doubt by this time reached the very district he is specially to investigate. From Jaluit he will proceed to other islands in the neighbourhood.

FROM an early sheet of *Petermann's Mittheilungen* we learn that the Dutch exploring vessel *Willem Barents* arrived at Hammerfest on September 24, having succeeded in reaching Franz Josef Land. The expedition encountered stormy weather in September, and found much ice in the Kara Sea and to the north of Novaya Zemlya. M'Clintock Island, in the south of Franz Josef Land, was surrounded by ice, and on the return journey ice was found east of the 55th degree. They left the *Isbjörn* in Matotschkin Scharr. This *Isbjörn* is the little Norwegian cutter in which Capt. Albert Markham and Sir Henry Gore Booth have been cruising in the Novaya Zemlya seas, and which reached Tromsø on September 22. On June 4 they met with the first ice forty miles from the west coast of Novaya Zemlya, and finding Matotschkin Scharr impassable, they sailed along the west coast of Novaya Zemlya to Cape Nassau, when the *Isbjörn* was stopped by ice. Returning again, the Matotschkin Scharr was passed, but the Kara Sea was full of masses of ice. On their return they fell in with the *Willem Barents*, and Markham decided to press northwards again, and this time succeeded in reaching, on September 6, Cape Mauritius, the north point of the island. Pressing still further northward between Novaya Zemlya and Spitzbergen, the *Isbjörn* reached 78° 24' N. lat., only about eighty miles from Franz Josef Land.

ADVICES received from St. Lawrence Bay state that the American Polar exploring vessel *Jeannette* arrived there on August 25, and sailed for Cape Serdze Kamen after taking in coal. It is believed that there is a prospect of an open winter in the Arctic Sea this year.

IN his last official report from Copenhagen, Her Majesty's Consul states that the Danish war vessel *Fylla*, which during the fishing season is stationed off the coast of Iceland, has made some deep-sea soundings and measurements, and brought home many interesting particulars respecting the currents and temperature of the Polar Sea. On one of these expeditions she penetrated so far north in the ice as to find cold water (*i.e.*, under freezing point) from two fathoms below the surface to the bottom, by which was proved the presence of an ice-cold polar current; the existence of this had not been previously ascertained, owing to the impenetrable ice-masses. The soundings were taken both on the north coast and in Denmark Sound. The extent of the polar ice is varying and changeable, for at the time the *Fylla* was able to penetrate many miles direct north in open water from North Cape, Iceland, a mail steamer could not enter Ofjord owing to the ice, and a French war steamer was stopped by ice about five miles from the coast between these points. During the whole time the *Fylla* met with very much drift-wood, which increased in quantity as she advanced northwards. The foregoing notes are of considerable interest when considered in connection with portions of Mr. G. F. Rodwell's letter from Iceland, in last number.

THE October number of the Geographical Society's monthly periodical opens with a long paper by Capt. G. Martin, on the information obtained in regard to the Kurram Valley during the survey operations of the Afghan expedition. At the present juncture, this paper will, no doubt, be read with much interest, but, though the author states that "he has endeavoured to be as brief as possible," we incline to the opinion that his

observations might with advantage have been very considerably curtailed. In the geographical notes we find news respecting the Rev. T. J. Comber's expedition to the Congo, Danish discovery on the coast of Greenland, and the Dutch Arctic expedition. Some further particulars in regard to Mr. Keith Johnston's sad death and the East African expedition are also included under this head.

THE Marine Survey Department, Calcutta, has lately issued a hydrographic notice which contains some information in regard to Pemba Island and the adjacent coast of East Africa. The island is thirty-eight miles long and about thirteen miles wide, including the islands on its western side, which protect the numerous harbours there. The east coast is rocky and straight, with only a few slight indentations. The height of Pemba Island does not exceed 300 feet, and the surface is broken into ridges and valleys, covered with luxuriant vegetation. The soil is rich, the chief produce being cloves, most of the groves of which are situated on the west side of the island. All tropical cereals and edible roots flourish, and on the eastern side the Wapembe, or descendants of the aborigines, keep large herds of cattle. Cocoa-nuts abound, but no oil-making is carried on, most of the nuts being consumed locally and the remainder sent to Zanzibar to be converted into oil. The greater part of Pemba Island is under cultivation, or is grazing-land, but a little forest exists here and there. The island is governed by a Wali, appointed by the Sultan of Zanzibar, and residing at Chaki Chaki, the only place of any importance.

NOTES

WE learn that Dr. Thwaites, F.R.S., C.M.G., has resigned the directorship of the Royal Botanic Gardens, Peradeniya, Ceylon, to which he was appointed in 1849. This step has been for some time contemplated by Dr. Thwaites, on whose somewhat feeble health the charge of the botanical interests of the island, especially in relation to the coffee-leaf disease and the introduction of new kinds of cultivation, has of late pressed heavily.

IN a recent paper to *La Nature* on the employment of the hydro-electric batteries and Reynier lamps for domestic lighting, M. Reynier comes to the following conclusions:—The most powerful battery is the Bunsen, Ruhmkorff model; but it is inconvenient and deleterious, and expensive. The most economical and constant battery is the Thomson; but it is costly and cumbersome. The most convenient battery would be a well-arranged rotatory one; but the price would be high (200 fr. at least) and the daily cost enormous. A battery as powerful as the Bunsen, as economical as the Thomson, and as convenient as a well-arranged rotatory one, would still be far from suitable for electric lighting. Hence it is not at present among hydro-electric batteries that we have to look for the solution of a domestic motor applicable to the present electric lamps.

As will be seen from our advertising columns, the Council of the Entomological Society of London is authorised by Lord Walsingham and other gentlemen interested in the diseases of our native game birds to offer to public competition the following prizes:—50*l.* for the best and most complete life-history of *Sclerostoma syngamus*, Dies., supposed to produce the so-called "gapes" in poultry, game, and other birds; 50*l.* for the best and most complete life-history of *Strongilus pergracilis*, Cob., supposed to cause the grouse disease. No life-history will be considered satisfactory unless the different stages of development are observed and recorded. The competition is open to naturalists of all nationalities, and the same observer may compete for both prizes. Essays in English, French, or German, to be sent in on or before October 15, 1882, addressed to the

Secretary of the Society, 11, Chandos Street, Cavendish Square, W.

THE death is announced of Prof. Mohr, of Bonn University, at the age of seventy-two. Mohr, like his father, was originally an apothecary at Coblenz. In 1864 he was attached to Bonn University, and some of his works on chemistry, geology, and physics have been translated into foreign languages. His activity was inexhaustible.

AN experiment was tried on October 4 by M. Menier, in a large park belonging to him at Noyelles, on the banks of the Marne, about 50 kilometres from Paris, on the Eastern Railway. A part of the water power which he uses for his workshop operates on eight ordinary Gramme machines producing the current for the Serrin regulators or Jablochkoff candles. The current of two of these machines was sent into the park at a distance of 700 metres, where two others had been arranged on a truck and connected with a plough by a dragging rope. A number of furrows were then traced with this simple apparatus, and have been found equal to the work of four oxen. The experiment has been found so successful that M. Menier intends devoting a water-power of thirty horses to agricultural work round his workshop. He intends using water-pipes for placing his insulated copper wires, and expects to conduct his power to 5 kilometres from his mill in every direction, so to perform various agricultural operations on a surface of more than ten square miles.

THREE different telephonic companies are competing in Paris, viz., the Gower (magnetical), Bell, and Edison, the two latter working with the microphone. It is said that the Bell and Edison Companies will enter into a working arrangement, or a fusion.

THE city of Lille, in French Flanders, sends every year to England the best English scholars of the Municipal School. This year the journey made at the expense of the city has taken unprecedented extension. The number of travelling pupils was twenty-three, and the excursion occupied a fortnight, during which not only London, but Edinburgh, Dundee, Glasgow, Newcastle, Durham, and York were visited.

THE tramway from Naples Observatory to the foot of the cone of Mount Vesuvius is nearly completed, and will be opened early next year. A steam-engine at the summit will draw the trams up by a windlass on Spielg's system.

WE understand that by the retirement of Dr. Gilchrist from the charge of the Crichton Asylum at Dumfries, a very important and valuable appointment is now open to the psychological branch of the medical profession.

A FACULTY of Medicine has been created at Bordeaux. M. Ferry, the Minister of Public Instruction, will be present at the ceremony of laying the first stone.

THE French Minister of War has published a regulation for organising optical telegraphy in time of peace. The several places on the French frontier are to be connected by posts; apparatus are to be manœuvred by persons trained and keeping records of communications sent or received. This new service is to be placed under the supervision of the Director of Aërial Communications, who already has command of the balloonists and the colombophiles for carrier-pigeons.

THE *Times* Geneva correspondent states that a fisherman has found a very remarkable weapon near the lake-dwelling of Locras, in the Lake of Brienz. It is a double battle-axe of pure copper, forty-two centimetres long, and weighing three kilogrammes. Massive and heavy in the middle, it broadens out gradually into two cutting edges, each having a width of twelve

centimetres. It has been added to the collection of Dr. Gross, at Neuveville. Several similar weapons have been found in Denmark; but, so far as is known, this is the first of the kind discovered in Switzerland. The lake-dwelling of Locras is assigned by archaeologists to the age of stone.

AT Trier (Treves) a fresh discovery of colossal remains of Roman structures has recently been made. They consist mainly of a large wall, 1·88 metres thick, with two other ones running parallel to it and only 90 centimetres apart. Between the latter two, at a depth of 8 metres below the present surface of the ground, there is a vaulted canal, and a little further on an enormous cellar vault. The foundations of the two parallel walls have in some parts not been reached at a depth of 9 metres. Archaeologists are at present at a loss to know what may originally have been the nature of the structure, as nothing at all resembling it has ever been discovered.

WE have received from the Dundee Naturalists' Society very satisfactory reports of the work done during the sessions 1877-8-9.

IN a recent communication to the Vienna Academy, on the cause of excitation of electricity in contact of heterogenous metals, Prof. Exner offers proof that the electromotive force is always in direct relation to the heat of combustion of the metals in question, provided they are in air. Such proof is quantitatively furnished for the combinations of Zn, Cu, Fe, and Ag, with Pt. Further it is shown that the so-called contact-force of two metals changes, whenever these are no longer in air, but in some gas acting in a different way on them chemically. Numerical proof of this is given in the case of Ag, according as this metal is in air or in an atmosphere of chlorine. Since the numerical values obtained in this research, for the contact-force, as also the few older determinations are in full harmony with the chemical theory of this mode of electric excitation, and the experiments are contrary to the voltaic theory, the author considers further adherence to the latter impossible.

THE radicles of seeds lying on the surface of the ground penetrate into the ground only under certain conditions. According to recent observations by Dr. Richter, of Vienna, these are of the following nature:—1. The penetration takes place only when the temperature exceeds a certain minimum above the lower zero of germination, depending on the species of the plant. 2. This minimum is much lower, for one and the same plant species, if the seedling is exposed to light, than if it is kept in darkness, the reason being that in the former case a transformation of light into heat occurs (as shown by experiments of cultivation at temperatures above the optimum of germinating temperature of particular plants). 3. A pressure of the roots on the ground, whether through formation of root-hairs, or from external causes, favours the penetration of the roots. 4. The nature of the ground affects the penetration of roots, only in that the latter occurs more easily the less resistance the ground presents to the roots. 5. Geotropism is naturally concerned most largely in the penetration of the roots. The light affects it in so far as by production of heat, it favours the growth generally, and therewith the geotropic downward-bending. On the other hand, negative heliotropism is (contrary to expectation) not concerned in penetration of illumined roots into the ground.

THE Rouen journals report an invasion of swarms of bees in several houses of the town. In a confectioner's establishment legions of these bees took possession, making it impossible for the workmen to continue their occupations. Nearly every inmate of the place was stung, and one person was maltreated so severely that medical aid had to be called in. An attempt was made to get rid of these importunate guests by burning sulphur to asphyxiate them, but the bees took refuge in the upper storeys

and when the smoke had abated, they descended again, and were as troublesome as before.

THE general meeting of German Archaeologists and Historians took place at Landshut (Bavaria) on September 14 last, and was well attended by members from all parts of Germany. Prof. Ohlenschläger, of Munich, delivered the first lecture "On the Survey made of the so-called Devil's Wall in Bavaria." Great interest was evinced in a paper read by Prof. Rhiza, of Vienna, "On the Marks made by Masons and Stone Workers at different Periods and in Different Districts."

KARL VON SCHERZER, Austrian Consul-General at Leipzig, has been nominated honorary member of the Senkenberg Natural History Society at Frankfurt-on-the-Main.

THE "Oberlausitzische" Scientific Society at Görlitz (Silesia) celebrated the centenary of its foundation on October 8. At the same time the 153rd General Meeting of the Society took place.

At the Baden-Baden meeting of the International Society for the Prevention of the Pollution of Rivers, the Soil, and the Atmosphere, which took place on September 16 last, the three principal addresses were by Professors Reclam, of Leipzig, Vogt, of Berne, and Ewich, of Cologne. Prof. Reclam spoke on canalisation and the pollution of rivers in Germany and England; Dr. Vogt on the influence of the sun upon the walls of houses; and Dr. Ewich on the origin of springs and wells.

It may interest our readers to know the elevations which at present are reached by lines of railway in different parts of the world. The Apennine Railway reaches its highest point at an elevation of 617 metres above sea-level; the Black Forest Railway ascends to 850 metres, the Semmering line to 890, the Caucasus line to 975 metres. The St. Gothard tunnel is 1,154 metres above sea-level; the railway across the Brenner reaches 1,367 metres; the Mont Cenis Railway ascends to 1,338 metres, the North-Pacific line to 1,652, the Central-Pacific to 2,140, and the Union-Pacific to 2,513 metres. The highest of all is the line across the Andes, which reaches an elevation of 4,769 metres.

DR. BRAUNS, of Halle, has been appointed Professor of Mineralogy and Palæontology at the Japanese University of Tokio. It is stated that some twenty-five amongst the teachers at this University are Germans.

AT Carlsruhe a meeting of a large number of agricultural chemists from all parts of Europe took place on September 16 and 17 last.

WE have a satisfactory report of the Queenwood Mutual Improvement Society for the end of the summer term 1879. A good deal of practical natural history work seems to be done by the members, and the report contains an interesting account of three carrion crows that were tamed by some of the boys, remaining about the premises, "showing themselves as familiar and companionable as the most faithful dogs."

ON Thursday last the Chester Society of Natural Science held a very successful *conversazione*. The Kingsley Memorial Medal, established in memory of the Society's first president, was awarded to Sir P. de M. Grey Egerton, for "having contributed materially to the promotion and advancement of natural science," and the Kingsley Memorial Prize to Mr. G. Shrubsole, jun., for his collection of fossils illustrating the carboniferous limestone, millstone grit, and coal measures.

MR. F. H. BROOK, of Walworth, has sent us a useful Price List of Electrical Apparatus, containing upwards of 450 items.

THE annual exhibition of the Photographic Society was opened on Monday, at the Gallery, 5, Pall Mall, East.

WE very much regret to learn that the publishers of the *American Chemist* have been obliged to discontinue the publication of that valuable journal.

A DISCOVERY calculated to throw some light on prehistoric man has recently been made by the excavation on the banks of Lake Ladoga of a human skeleton belonging to the stone period, along with many well-preserved skulls and bones, remains of plants and animals, and instruments of stone and bone. These remains were found at a depth of from about 12 to 20 feet below the surface of the lake.

TWO shocks of an earthquake were felt at Annecy, Savoy, at 4 A.M. on Saturday, both accompanied by a rumbling noise.

MR. STANFORD has published a useful Section of British Strata, showing the order of superposition and maximum thickness of strata in the British Islands, by Mr. James B. Jordan. The section was originally prepared as an Index of Colours to Stanford's Geological Map of the British Islands, edited by Prof. A. C. Ramsay, by whom it has been revised and corrected.

THE Museum of the French Colonies at Paris, which, as we stated, has received a sensible augmentation by the addition of a large part of the Algerian collections, is undergoing a total reorganisation. A new director and sub-director have been appointed.

THE Peking correspondent of the *North China Herald* learns that the engagement of the geologist and mining expert, Mr. Arnold Hague, by Li Hungchang, has terminated, owing to the obstructions constantly put forward by the Central Government. A few metal-bearing localities have been examined, but nothing definite has been learned of the resources of the province of Chihli. At the date of the letter referred to Mr. Hague was at Peking, on his way to Mongolia, where he intends to make some excursions, partly with a view to scientific investigations. He will afterwards return to the United States to take up an official appointment in connection with certain new systematic surveys which it has been determined to make there.

THE Government of Victoria have just appointed a board to advise them as to the best mode in which assistance can be given to further the development of the auriferous and mineral resources of the colony.

No. 3 of "Dimmock's Special Bibliography" (Cambridge, U.S.) consists of a full list of the writings of Samuel Hubbard Scudder, which ought to be specially valuable to entomologists.

WE have on our table the following works:—"The Spiders of Dorset," Rev. O. Pickard Cambridge; "Chemical and Geological Essays," by T. Sterry Hunt (Trübner); "Deaths in Childhood," Dr. Aeneas Munro (Smith, Elder, and Co.); "The Silk Goods of America," W. C. Wyckoff; "Structural Botany," Dr. Asa Gray (Trübner); "Luxurious Bathing," A. W. Tuer (Field and Tuer); "Phrenology Vindicated," A. L. Vago (Simpkins); "On the Diffusion of Liquids," J. H. Long (H. Laupp); "Reform Essays on Incentive Religion and Warfare," "Farming for Pleasure and Profit" (Poultry Keeping), Arthur Roland (Chapman and Hall); "Manual of Practical Anatomy," J. Cossar-Ewart (Smith, Elder, and Co.); "Rays from the Realms of Nature," Rev. James Neill (Cassell); "Jack's Education; or, How He Learnt Farming," Prof. Henry Tanner (Chapman and Hall); "Vocal Physiology and Hygiene," Gordon Holmes (Churchill); "Fauna der Gaskohle und der Kalksteine der Perm Formation Böhmens," Dr. Ant. Fritsch.

THE additions to the Zoological Society's Gardens during the past week include a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Sir Arthur Scott, Bart.; a White-

cheeked Capuchin (*Cebus lunatus*) from South America, presented by Mr. Adrian Hope, F.Z.S.; an American Red Fox (*Canis fulvus*), a Rough-legged Buzzard (*Archibuteo lagopus*) from Labrador, presented by Lord Hobart; three Vulturine Guinea Fowls (*Numida vulturina*), a Crested Guinea Fowl (*Numida cristata*) from East Africa, presented by Vice-Admiral John Corbett, C.B.; two Malabar Mynahs (*Sturnia malabarica*) from Hindostan, a Chinese Mynah (*Acridotheres cristatellus*) from China, a Waxwing (*Ampelis garrulus*), European, presented by Mr. A. F. Weiner, F.Z.S.; five Fat Dormice (*Myoxus glis*), European, presented by Mr. Edwin Liot; seven Green Tree Frogs (*Hyla arborea*), a Green Lizard (*Lacerta viridis*), three Spotted Salamanders (*Salamandra maculosa*), European, presented by the Rev. S. R. Wilkinson, F.Z.S.; an Anaconda (*Eunectes murinus*) from South America, presented by Capt. E. Ball; an Elliot's Guinea Fowl (*Numida ellioti*), a Vulturine Guinea Fowl (*Numida vulturina*), three Mitred Guinea Fowl (*Numida mitrata*) from East Africa, a Booted Eagle (*Nisaeetus pennatus*), European, purchased.

ON THE GRADUAL CONVERSION OF THE BAND SPECTRUM OF NITROGEN INTO A LINE SPECTRUM

PROF. WÜLLNER, of Aachen, has recently published a treatise on the two different views which are held by physicists with regard to the various spectra presented by gases which are rendered incandescent by means of induction sparks. One of these views was first stated by Ångström, who thought that for a certain gas only one spectrum was possible, and that this spectrum consisted of lines only. All band spectra which occasionally appeared when gases were examined in the way mentioned, he ascribed to impurities. The band-spectrum of nitrogen, according to his idea, belonged to oxides of that element. He believed that as long as the current passed through the gas without giving a spark, the oxide was rendered incandescent as such, without decomposition, and that the spark decomposed the oxide, and that only then the nitrogen could give its own line-spectrum. Later on Ångström modified this view, and admitted that an elementary substance might give several spectra when rendered incandescent in the gaseous state, but he still held that in this case the element in question entered into isomeric compounds with itself, and that the different spectra belonged to different isomeric compounds. Mr. Lockyer afterwards defined this view more clearly, stating his opinion that the line-spectrum is produced by simple atoms, and the continuous or channelled-space spectra by conglomerations of molecules.

Prof. Wüllner, however, does not consider this hypothesis necessary for the explanation of the different spectra of elements, but holds that they may be explained by Kirchhoff's maxim. Prof. Zöllner has pointed out that the light emitted by a radiating layer of gas must essentially depend on the thickness and density of the layer. Prof. Wüllner, therefore, after having first confirmed the fact that the line-spectrum of elementary gases only appears with the real electric spark, the band-spectrum, however, when in the gas the electro-positive brush and glow appears, ascribes the different spectra to the differences in the radiating layers of gas. He believes that in the spark only the molecules struck by the spark are glowing, therefore almost only a linear row of molecules; thus in the spectrum only the absolute maxima of the emission power, which correspond to the temperature of the spark, become apparent. If, however, in the positive brush light the whole quantity of gas contained in the spectral tube is rendered incandescent, then it is always a relatively thick layer which emits light; in the spectrum all those kinds of light must show themselves for which at the respective temperature the power of emission is above zero. But since the incandescent gas is always of relatively small density, all the differences in the emission power of the various kinds of light must become apparent in the spectrum, and thus the latter must be richly varied or shaded; this is indeed the case in the band-spectra of gases. Prof. Wüllner adduces the spectra of iodine vapour as proofs of the correctness of his view. When rendered incandescent by means of a hydrogen flame, iodine vapour gives the negative absorption spectrum, which is of the same character as the band-spectra of gases; if rendered incandescent through the spark, the glowing iodine molecules give a bright line-spectrum.

The band-spectrum of nitrogen shows, that this element at the temperatures obtained by electric discharges possesses quite as great a power of absorption as that of iodine vapour at low temperatures, because the band-spectrum of nitrogen is essentially of the same character as that of iodine vapour, however different it may be from it in detail. Of all other gases, nitrogen must therefore be particularly adapted for showing, through the examination of the light it emits, the dependence of spectral phenomena from the thickness and density of the radiating layer of gas, and thus for furnishing the proof that there is no constant spectrum of nitrogen, but that a certain spectrum exists only at a certain temperature and density of the gas. This indeed is the question upon which turns the difference of opinions of Ångström and Lockyer on the one hand and of Wüllner and Zöllner on the other; the former ascribing the different spectra to chemical differences in the molecular conditions of the gas, the latter merely to differences of temperature, density, and thickness of the radiating layer.

In a former treatise on the nitrogen spectrum, Prof. Wüllner, without having recognised the importance of the density of the radiating layer with regard to the light emitted, pointed out that when the pressure in a nitrogen tube is diminished to such an extent that it ceases to be measurable, the brightness of the spectrum decreases, and in such a manner that the darker parts first fade away, so that at last only the brightest parts remain. He added that in this way the nitrogen spectrum in its character approaches a spectrum of the second order (the name given to line spectra by Plücker) without, however, changing to the nitrogen spectrum of the second order, since no new bright lines appear. At that time, however, Prof. Wüllner did not continue his researches in that direction, and in particular he did not examine whether the bright parts remaining do indeed correspond to the maxima of the complete band spectrum, because the spectra he obtained at those pressures were too weak to allow of measurements being made with the instruments then at his disposal. Lately, however, the Professor has minutely examined the nitrogen spectrum in this sense, employing a simple contrivance for rendering the spectra bright enough for measurements, even at the lowest pressures. This consisted in the employment of spectral tubes of very narrow calibre (about 2 mm. in diameter).

It must be remembered here that the temperature of the gas, which is caused by the induction current, rises with decreasing diameter of the tube. (If, however, the tubes were taken too narrow, the current at once broke them.)

Since the resistance in the tube rises as the density of the gas decreases, at least from a certain point of low pressure downwards, the temperature rises as well. If the rise in the temperature was sufficiently great, the experiment described by Prof. Wüllner necessarily decided the only hypothetical part in his conception of spectral phenomena, viz., whether with a rising temperature the absorption power for the various kinds of light grows in a similar manner or not. If it does grow simultaneously with the temperature, then the relative maxima of intensity of light which the complete band spectrum shows must always remain the same; the bright parts remaining at the lowest density must correspond to the maxima of the band-spectrum. If the contrary is the case, and this is what Prof. Wüllner assumes, then dark parts in the band-spectrum may become the brighter ones as the density decreases, and the bright parts remaining at the lowest pressure may be situated at places in the spectrum differing widely from the maxima of the band-spectrum. The first part of the experiment therefore consisted in an exact determination of the relative maxima in the band-spectrum of nitrogen for the sake of comparison. This is minutely described in Prof. Wüllner's paper. The final results of the observations were in complete accordance with the Professor's conception of the spectral phenomena. There is indeed no definite nitrogen spectrum when in layers of sufficient thinness the density of the gas is reduced below a certain limit. The band spectrum changes step by step into a line-spectrum; this, however, is not identical with the line-spectrum produced by the spark, but has only a certain number of lines in common with it. In this gradual change it is easy to follow the displacement of the maxima of brightness which takes place little by little as the temperature rises, and is quite conspicuous in several places; this displacement is the very cause why in this line-spectrum the lines in places differ widely in their situation from the maxima of brightness of the band spectrum.

Prof. Wüllner then gives an exact description of that part of